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EXAMINER

GEBREMARIAM, SAMUEL A

ART UNIT PAPER NUMBER

2811

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Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/707,065

Applicant(s)

COOLBAUGH ET AL.

Examiner

Samuel A. Gebremariam

Art Unit

2811

– The MAILING DATE of this communication appears on the cover sheet with the correspondence address –

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 21 December 2005.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

**DETAILED ACTION**

***Claim Rejections - 35 USC § 102***

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1-9, and 19-20 are rejected under 35 U.S.C. 102(b) as being anticipated by Chen, US patent No. 6,287,931.

Regarding claim 1, Chen teaches (fig. 2D and col. 4, lines 38-47) a semiconductor structure comprising a high performance metal stacked inductor (28, col. 4, lines 38-47) having a relatively low sheet resistance (metal have low sheet resistance), the metal stacked inductor comprising at least one first layer of metal (28) which serves as an upper metal wire in the semiconductor structure (20) and a second layer of metal (col. 4, lines 38-47 state that two or more metal layers can be stacked to implement the spiral conductive layers 28) located directly on top of the first layer of metal (28), wherein the first layer of metal (28) contact with a lower metal wire (24) by a via (26) and the first layer of metal (28) and the second layer (col. 4, lines 38-47) of metal are not interconnected by a via (refer to fig. 2D).

Regarding claim 2, Chen teaches (fig. 2D) the entire claimed structure of claim 1 above including a third metal layer (col. 4, lines 38-47) located directly on top of the second layer of metal, wherein the second layer of metal and the third layer of metal are not interconnected by a via (refer to fig. 2D).

Art Unit: 2811

Regarding claims 3 and 4, Chen teaches (figs 1 and 2) the entire claimed structure of claims 1 and 2 above including the metal-stacked inductor is spiral shaped (col. 4, lines 38-47).

Regarding claim 5, Chen teaches the entire claimed structure of claim 1 above the first layer of metal is connected to a lower metal wiring level (24, 26).

Regarding claim 6, Chen teaches (fig. 2D) the entire claimed structure of claim 1 above including the lower metal wiring level (24,26) comprises a wiring region embedded within an interconnect dielectric (25).

Regarding claim 7, Chen teaches (fig. 2D) the entire claimed structure of claim 1 above including at least one wiring region (24,26) that lies to the periphery of the metal stacked inductor, wherein in the at least one wiring region the second layer (26) of metal serves as a via interconnecting two metal wires (24) and (28).

Regarding claim 8, Chen teaches the entire claimed structure of claim 1 above including the first layer of metal is comprised of a low resistivity conductive material having a resistivity of about 3.0 micro-ohm\*cm or less (Chen uses Al-Cu alloy as the layer of metal and Al-Cu alloy has a resistivity of about 3.0 micro-ohm\*cm or less).

Regarding claim 9, Chen teaches the entire claimed structure of claims 1 and 8 above the low resistivity conductive material is Al-Cu alloy.

Regarding claim 19, Chen teaches (figs. 2A-2D and col. 4, lines 38-47) providing a partial interconnect structure comprising a lower metal wiring level (24,26) located on a substrate (20), forming a first dielectric material (29) on the partial interconnect structure (24); forming a first layer of metal (28) in the first dielectric material (29), the

Art Unit: 2811

first layer of metal as the bottom layer of a metal stacked inductor (col. 4, lines 38-47); and forming a second layer of metal (col. 4, lines 38-47, states that two or more metal layers can be used to form coil 28) on the first metal layer, wherein the first layer (28) of metal is in electrical contact with a lower metal wire (24) by a via (26); and the first layer (28) of metal and the second layer (col. 4, lines 38-47, does not mention any via connecting the stacked metal) of metal are not interconnected by a via (refer to fig. 2D).

Regarding claim 20, Chen teaches substantially the entire claimed process of claim 19 above including forming a third layer of metal (col. 4, lines 38-47 states that two or more layers of metal can be stacked to form the coil 28) directly on top of the second layer of metal, wherein the second layer of metal and the third layer of metal are not interconnected by a via (refer to fig. 2D).

### ***Claim Rejections - 35 USC § 103***

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 10 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen in view of Chaudhry et al. US patent No. 6,639,298.

Regarding claims 10 and 13 Chen teaches substantially the entire claimed structure of claims 1 and 8 above except explicitly stating that the low resistivity conductive material is Cu.

It is conventional and also taught by Chaudhry (fig. 9) using Cu in the process of forming a multi-layer inductor structure.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use copper in the structure of Chen as taught by Chaudhry in order to form a high Q inductor.

5. Claims 11-12 and 14-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen in view Chaen, US PG-PUB 2002/0125575.

Regarding claims 11-12, Chen teaches substantially the entire claimed structure of claim 1 above except explicitly stating that the second layer of metal is comprised of a low resistivity conductive material having a resistivity of about 3 micro-ohm\*cm or less and the second layer of metal is selected from the group consisting of Cu, Al, Pt, Ag, Au, and alloys thereof.

Chaen teaches a first metal layer (6), second metal layer (10) and third metal layer (12) in the structure of forming a stacked inductor.

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to pick the second and third metal layers as taught by Chaen in the structure of Chen in order to form an inductor structure with improved Q factor. Therefore the combined structure of Chen and Chen would have the second layer of metal that is comprised of a low resistivity conductive material having a resistivity of about 3 micro-ohm\*cm or less and the second layer of metal is Au ([paragraph (0033)])

Art Unit: 2811

Regarding claims 14-15, Chen teaches substantially the entire claimed structure of claims 1 and 2 above including the third layer (12, Chaen) of metal is Au having a resistivity of about 3 micro-ohm\*cm.

6. Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chen, Chaen and in view of Park et al., US patent No. 6,395,637.

Regarding claim 16, Chen teaches substantially the entire claimed structure of claims 1, 2 and 14 above except explicitly stating that the low resistivity conductive material is aluminum.

Park teaches (fig. 4C) a third metal layer (21a) that is made of aluminum.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use Al in the structure of Chen as taught by Park in order to form a high Q inductor.

7. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chen, in view of Park et al., US patent No. 6,395,637.

Regarding claim 17, Chen teaches substantially the entire claimed structure of claim 1 above except explicitly stating that the first layer of metal is comprised of Cu and the second metal layer is comprised of Al.

Park teaches the use of stacked metal structures using copper and aluminum to form an inductor structure (fig. 2C of Park).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use Cu and Al layers taught by Park in the structure of Chen in order to form a high Q inductor.

8. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chen, Chaudhry, and in view of Park.

Regarding claim 18, Chen teaches substantially the entire claimed structure of claim 2 above except explicitly stating that the second layer of metal is comprised of Cu and the third layer of metal is comprised of Al.

Chaudhry teaches (fig. 9) using Cu in the process of forming a multi-layer inductor structure.

Park teaches using Al as a third metal (21a) in the process of forming an inductor (fig. 4C)

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made combine both Cu and Al as taught by both Park and Chaudhry in the structure of Chen in order to form a high Q inductor.

#### ***Response to Arguments***

9. Applicant's arguments with respect to claims 1-20 have been considered but are moot in view of the new ground(s) of rejection.



Art Unit: 2811

**Conclusion**

10. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Samuel A. Gebremariam whose telephone number is (571) 272-1653. The examiner can normally be reached on 8:00am-4:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Lee can be reached on (571) 272-1732. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

SAG  
March 12, 2006



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